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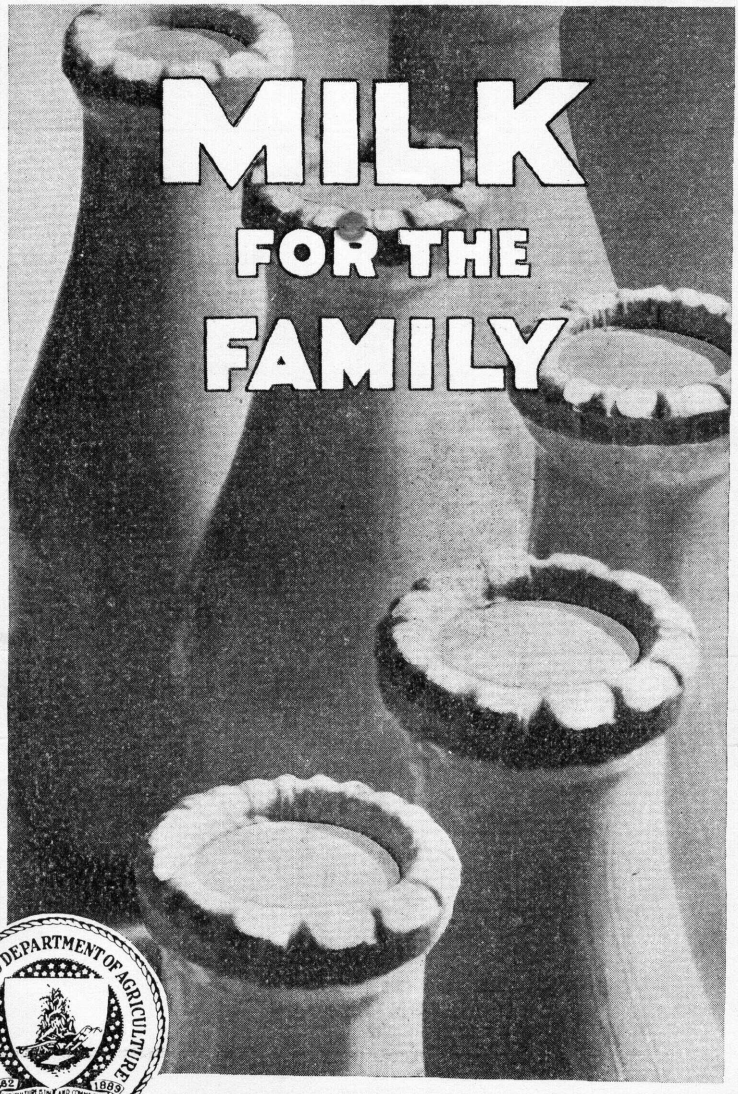

EVERY HOME MAKER SHOULD KNOW—

What milk contributes to the well-balanced diet
How much milk the family needs
Something about grades and quality of milk
Why milk is commercially pasteurized
What milk to select for the baby
How to care for milk and cream at home
The value of milk in its various forms
Many ways to use milk and its products

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MILK FOR THE FAMILY

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CONTENTS

THE CONSUMPTION OF MILK

MILK AND MILK PRODUCTS are important items in the diet of farm families in the United States. About 70 percent of the farms have one or more milch cows, and milk is available on most of these farms throughout the year. On farms producing milk, the quantity consumed per person per day averages about 1 pint of whole milk, the cream from about one half pint of milk, and about three fourths of a pint of skim milk and buttermilk. These are figures for 1932, based on averages for the country as a whole. They do not include the large quantity of cream used on the farm for making butter.

The relative quantities of whole milk, cream, skim milk, and buttermilk, as well as the total quantity of dairy products consumed on farms, vary considerably with the section of the country and with the individual family. Whole milk is used most liberally in those States where the milk is low in fat content. The use of cream increases on farms as elsewhere in times of prosperity. On most farms where skim milk is available, considerable quantities are used to drink, in cooking, and for making cottage cheese. Skim milk takes a place of great importance in the farm diet when incomes are low and families must economize closely.

In cities and villages the consumption of milk averaged about nine tenths of a pint per person per day in 1931. The figures on which this average is based were collected by city boards of health and summarized by the Bureau of Agricultural Economics, and include milk from which only the cream is used. During the same

year the average quantity of evaporated milk used was about six tenths of an ounce per person per day, and of condensed milk, about one tenth of an ounce.

Selling market milk in half-pint bottles has done much in recent years to encourage the drinking of milk away from home. The amount of milk ordered with meals over lunch counters, in restaurants and dining cars, school cafeterias, and hotels has increased. Also it is now common for men working indoors and out to drink milk with their lunches.

THE MILK QUOTA

Milk in some form might well furnish one fourth of the total calories used by the average American family. In terms of money value, from one fifth to one third of the allowance for food should be spent for milk and its products. An outstanding nutrition chemist says that whatever amount of money is available for the family's food, it is wise to spend at least as much for milk (including cream and cheese if they are used) as for meats, poultry, and fish.

The quantity of milk each person needs depends upon physical maturity, the variety of the diet as a whole, and any special needs, such as those of pregnancy. A generous daily allowance is 1 quart (or its equivalent in other dairy products) for every child, 1 quart for every pregnant or nursing woman, and 1 pint for every other adult. This includes milk used in food preparation as well as milk taken as a beverage.

If, because of limited stomach capacity or for some other reason, a child finds it difficult to take such a generous quota of milk even when part of it is used in preparing his food, then undiluted evaporated milk or a concentrated solution of dried milk may be used in cooking for him (p. 24). In varied diets, when milk is carefully supplemented in nutritive value by other foods, three fourths of a quart of milk daily may be adequate. Every growing child needs at the very least a pint a day, and an adult at least one half a pint. These very limited allowances do not fully meet the need for calcium, and the remainder of the diet should be selected with this fact in mind.

Families on low-cost diets need a generous milk allowance. They need the daily quart for each child and the pint for each adult. The less money there is for food, the more likely is the diet to be limited in variety and the more important that the whole family use plenty of milk and its products. In low-cost diets, either dried or evaporated milk may be used instead of fresh milk when these forms are less expensive.

NUTRITIVE VALUE

Milk contributes more to good nutrition than does any other single food. It has no equal among foods as a source of calcium, and is valuable also for other materials necessary throughout life. When taken in suitable quantities, milk is a dependable source of calcium, phosphorus, protein, vitamin A, and vitamin G. Milk contains also appreciable quantities of other vitamins and minerals. About two

thirds of the solids of milk consist of fat and sugar, which are sources of energy. The solids in milk total nearly 13 percent, a fact often lost sight of because milk is a liquid. Many foods that are "solid" in form contain less solids and more water than milk.

Because milk reinforces the diet in so many different ways, it is the soundest foundation on which to build wholesome meals for the family. Milk is valuable for maintenance in adults and for growth in children. Children's diets lacking or low in milk are almost always defective unless carefully supervised by a nutritionist who selects other foods that replace milk in nutritive value. Though this is possible, it is not easy. The simplest and safest way to provide the dietary essentials and to insure normal growth is to make milk the basis of the child's diet.

Milk is used to the best advantage when taken in combination with other foods. There is no perfect food that can alone fill all of the needs of nutrition, and though milk contains all of the nutrients of a balanced diet, they are not all present in ideal proportions. Milk cannot be depended upon for an adequate supply of some of the vitamins. The fuel or energy value of milk is insufficient for the adult. He would have to take 5 or 6 quarts of milk each day to meet all of his need for energy, and would meantime be taking unnecessary quantities of protein. Everyone except very young infants requires food richer in iron than milk is. Most healthy persons beyond babyhood require food containing a certain type and quantity of indigestible material to supply the bulk necessary to keep their digestive tracts in good condition. This material is not in milk, but is found in fruits and vegetables. For these reasons milk is supplemented by other foods very early in life, according to the best practices in infant and child feeding.

PROTEINS

Proteins are important building materials needed for the muscles and all other body tissues and fluids. They may serve also as fuel for the body. A certain quantity of protein is required every day for the upkeep of the human structure even in adult life, but the need is greatest before growth is completed. Many kinds of protein are found in foods. Milk contains two kinds, the principal one being casein, and the other lactalbumin, present in smaller quantities.

Proteins contain nitrogen, and all are made up of compounds known as amino acids. The combinations of amino acids found in the proteins of milk, eggs, meat, and other flesh foods are similar to those in the human body. For this reason these proteins are of special value for tissue building, and are called complete or efficient proteins. None is more efficient for growth and maintenance of the body than are the casein and lactalbumin of milk, and few foods supply efficient proteins at so low a cost as milk. This is especially true of skim milk, whether bought in liquid or in dried form.

SUGAR

Milk contains lactose, a sugar belonging to the group of nutrients called carbohydrates. Lactose is made commercially from the

whey of milk used in the manufacture of casein, and is marketed in both granular and powdered forms.

Like cane and beet sugars, lactose supplies energy to the body, but it is not so sweet and has less tendency to ferment and to irritate the stomach. Lactose has an important influence on the kind of bacteria found in the intestines. It favors the growth of lactic-acid bacteria and other desirable types, and makes conditions unfavorable for putrefactive bacteria, often present in excessive numbers in the intestinal tract. For this reason the patient who is put on a buttermilk or an acidophilus-milk diet is often advised to take several ounces of lactose daily. Another value of lactose is its somewhat laxative action. It is used to some extent in modifying milk for babies.

FAT

Whole milk contains fat in the form of small round droplets or globules, suspended as a natural emulsion. These globules are lighter than water and tend to rise to the top of the milk as it stands, forming a cream layer. From the commercial standpoint much of the value of milk lies in its fat content, often called butter fat, which may be separated and sold as cream, made into butter, or used in making certain cheeses. From the standpoint of nutrition, the fat of milk has special value, due to the presence of vitamins A and D. These vitamins are soluble in the fat and remain combined with it; therefore they occur in whole milk, cream, butter, and in cheese made of whole milk, but only to a very small extent in skim milk and its products and buttermilk. Due to its low melting point and emulsified form, milk fat is more easily digested than most fats. It is valued, too, for its pleasing flavor.

Because fats are the most concentrated sources of energy, the percentage of fat in milk influences its fuel value, or the number of calories it yields. Whole milk varies in fat content with the breed of cow and other factors, but averages about 3.9 percent. The quantity of fat in skim milk, buttermilk, cream, and butter is discussed in the section on milk products. However, the importance of milk fat in nutrition is as much a matter of its nutritive quality as of the quantity.

MINERALS

Calcium, phosphorus, and iron, three of the many minerals required by the body, demand special attention in planning the diet because they are not abundant in all foods. Milk, either whole or skimmed, is the most practical source of calcium known, and is a good source of phosphorus. Iron, necessary in the formation of red blood cells, occurs only in small quantities in milk, though what iron there is in milk is readily used by the body. Beginning early in infancy some iron-rich foods must be provided to supplement milk.

Phosphorus is needed in the make-up of every living cell, whether of the bone, tooth, muscle, or nerve tissue. Calcium is the chief mineral constituent of the bones and teeth, and an abundant supply

of it is essential for their growth. Bone and tooth tissues can develop and harden normally only when calcium and phosphorus are taken in good relative proportions in the diet, and when certain of the vitamins are also present.

The urgent need for phosphorus and calcium begins in the human being about 7 months before birth, when the number of cells is multiplying rapidly and the bone structure and tooth buds have begun to form. This need increases during the last weeks before birth when calcium is stored at a rapid rate by the developing skeleton. By the time the child is born, all of the crowns of his first teeth are formed in his gums, and four of his permanent teeth are partly developed in his jaws. The large demand for calcium during prenatal life and infancy is one reason for emphasizing the recommendation of a quart of milk a day for the pregnant and the nursing woman. During these two periods the woman must provide for her own calcium needs at the same time she meets the requirements of the developing fetus and later of the growing infant. There was some foundation for the old idea that each child cost his mother a

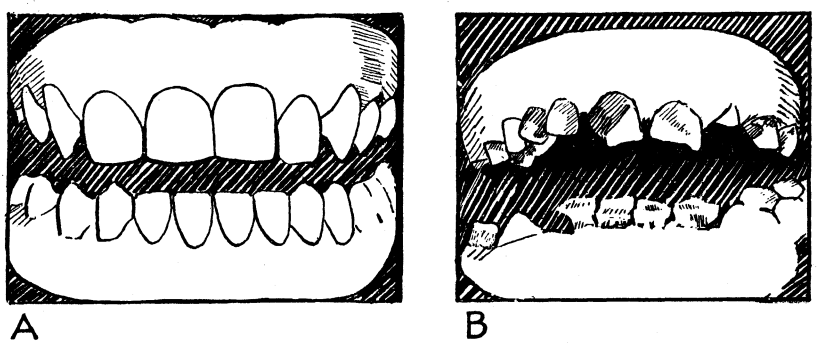

FIGURE 1.—The effect of diet on tooth-building. A, Sound, hard, healthy, well-constructed teeth of a boy of 15 years who had the proper tooth-building materials. His mother's diet during his prenatal life was well balanced, and his first teeth were sound. B, Porous, soft, decayed, irregular teeth of a boy of 10 years who never had the proper tooth-building materials. His mother's diet during his prenatal life was deficient, and his first teeth were poor. (Drawings adapted from photographs furnished by the Forsyth Dental Infirmary for Children, Boston, Mass.)

tooth because diets often did not contain sufficient calcium for both mother and child, and nature drew on the supply for the child first. This left the mother so depleted in calcium that her teeth were likely to soften or show decay.

During all the years of growth, the teeth are seriously affected by a diet low in calcium. They may fail to develop properly, they may not harden or calcify, and they may develop cavities. The influence of diet on teeth is often observed at children's clinics and in schools and institutions where food-habit records are taken in connection with regular health examination (fig. 1).

Repeated observations on children show that improving the diet in minerals and in certain vitamins checks the development of any tooth cavities that are started and prevents the beginning of new ones. Milk is always prominent in these corrective diets.

Throughout childhood, until all of the permanent teeth are erupted and the bone growth is completed, a daily milk quota of at least three fourths of a quart and preferably a whole quart is almost essential to insure the necessary calcium. With an inadequate supply of calcium and phosphorus, the bones may be stunted or may develop some of the deformities of rickets; with a liberal supply the body can build sturdy and healthy bones and teeth. The extent to which an individual attains the height set for him by heredity is influenced to a marked degree by the quantity of bone-building materials taken during the growing years. This is true also of the normal development of the jawbone and dental arch, which must grow properly if the teeth are to be well-spaced and regular in shape.

The need for calcium and phosphorus to keep the teeth and bones healthy continues throughout life. What has been said of cavities in children's teeth is true also to a large extent of those in adults' teeth. One of the principal reasons for calling milk an essential whole-family food is the difficulty of meeting calcium needs unless the diet of everyone includes some milk each day.

VITAMINS

Vitamins are substances in food that are necessary for good nutrition, though they are neither building materials nor sources of energy. They fall in the class of body regulators, and are better described in terms of what they do than of what they are. Vitamins as a group promote growth and make for health and vigor. Separately they provide resistance to certain infections, are responsible for normal bone and tooth development, stimulate a good appetite, and protect the body from "deficiency diseases" such as xerophthalmia, beriberi, scurvy, rickets, and pellagra.

With the exception of rickets and pellagra, typical cases of deficiency diseases are extremely rare in this country. Many persons, however, are below par in physical development and general health because their diet is just short of the quantity of certain vitamins needed for complete protection. Badly formed or decayed teeth, rickets, sluggish digestive systems, listlessness, and lowered resistance to many infections are often indications of a diet low, though not lacking, in several vitamins. To protect the body from conditions such as these is just as important a function of vitamins as to prevent the more conspicuous diseases named above. No single vitamin or single food can offer complete protection, but foods rich in vitamins and in certain minerals are called "protective foods" because of their everyday contribution to good health.

Whole milk is one of the important protective foods partly because each of the six vitamins so far discovered, A, B, C, D, E, and G, has been found in it, in large or small quantities. Two of the vitamins, A and G, occur abundantly in milk. Since no food is an excellent source of all six vitamins and few foods contain even small quantities of all of them, the vitamin content of milk is unusual and gives it a unique place among foods. However, most nutritionists agree that in addition to milk, other sources of vitamins B, C, and D should be provided in the diet to safeguard nutrition, especially in infancy.

VITAMIN A

Whole milk—fresh, dried, or evaporated—cream, butter, and cheese made from whole milk, or milk enriched with cream are excellent sources of vitamin A. This vitamin is necessary for normal growth, sound tooth structure, vitality throughout life, and reproduction. Vitamin A also keeps body tissues healthy, and in this way tends to increase resistance to bacterial infections such as those of the sinuses, throat, ears, and perhaps kidneys. A long-continued lack of this vitamin causes the eye disease xerophthalmia, with eventual blindness.

Fortunately the body can store a supply of vitamin A, and an abundance at one time may be of value later if for some reason the diet is low in it. However, during childhood, pregnancy, and lactation, it is safest to provide this growth-promoting vitamin constantly and generously.

The amount of vitamin A found in milk and its products depends somewhat on the type of feed and somewhat upon the breed of the cow but, in general, dairy products are considered rich sources. The vitamin A content is always high in milk from cows on green pasture, and may be kept up during the winter months if the feed is wisely selected. Modern dairy practices tend to maintain high nutritive value in milk especially in vitamin and mineral content.

Vitamin A is associated with the fat of the milk, so cream and butter are more concentrated sources than whole milk; skim milk, buttermilk, and skim-milk cheese have very much less vitamin A than whole milk. Commercially skimmed milk has very little. This vitamin is less easily affected by heat and oxidation than most others, which is the reason that whole-milk cheese and boiled, dried, canned, and pasteurized milk still retain a large part of their original content of vitamin A.

VITAMIN B

Milk is a fair though not rich source of vitamin B. Vitamin B stimulates the appetite and maintains normal muscle tone. Sluggish digestive tracts, nervous irritability, and the muscular paralysis of beriberi are due to insufficient vitamin B. This vitamin also influences the quantity and quality of human milk. Expectant and nursing mothers and growing children are particularly in need of vitamin B.

Since vitamin B is not stored to any extent in the body, a constant supply is necessary. Though the quantity in milk is not large, the daily use of an abundance of whole or skim milk, to drink and in cooking, makes it a fairly good source of this vitamin for most children and adults. Furthermore, the variety of fruits and vegetables and whole-grain products that should be included in the mixed diet beyond infancy usually brings the vitamin B content up to an adequate level. For nursing mothers, however, foods should be selected with special attention to the quantity of vitamin B they contain. And in infancy when the diet is largely milk, it is important to provide definitely for extra vitamin B by giving fruit and vegetable juices and purees, to the breast-fed as well as to the arti-

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ficially fed infant. Some specialists consider it desirable to give also extracts of wheat or corn germ, or rice polishings, or yeast to increase the vitamin B content of the young child's diet.

VITAMIN C

Raw milk contains only a small and variable quantity of vitamin C, and heated milk probably contains little or none. Yet vitamin C is essential for normal growth and stamina in children, and both adults and children need it for good tooth and gum nutrition. An extreme lack of this vitamin results in soreness and bleeding of the gums, decay and loosening of the teeth, fragility of the bones, and painful stiffness of the joints, which, are, together, the symptoms of the disease scurvy.

Vitamin C is not stored in the body. It is very easily destroyed by the heat used in ordinary cooking, except in such acid foods as tomatoes, so it is important to make sure that the diet contains vitamin C every day. A good many fruits and vegetables supply this vitamin if used raw. The richest sources are the citrus fruits, raw cabbage, raw turnips, and tomatoes—raw, cooked, or canned. The juice of oranges or tomatoes is given to very young infants, both breast and bottle fed, to supplement the small and uncertain vitamin C content of milk.

VITAMIN D

The fat of milk normally contains a small quantity of vitamin D, which becomes significant in the diet when whole milk, cream, butter, cheese, and ice cream are used liberally. Vitamin D is valuable throughout life, but is especially important for children in the normal development of their teeth and bones. Without enough vitamin D, rickets may occur and much of the bone structure may be malformed or stunted.

For vitamin D during infancy and early childhood, milk needs to be supplemented with foods rich in vitamin D. There are only a few good natural sources of this vitamin; egg yolk is one, and cod-liver oil is an especially rich source. Both egg yolk and cod-liver oil contain vitamin A also, and are important foods for children.

Vitamin D can be produced by ultraviolet rays acting on a substance called ergosterol. A number of foods and the skin of humans and animals contain ergosterol. Its presence in the human skin accounts for the action of sunshine and artificial sun-bath treatments in preventing and curing rickets and in promoting general good health. Vitamin D is stored in the body, so some of the value of sunlight in the summer carries over into the winter.

Exposing foods to the rays of an ultraviolet lamp is called irradiation. Some dried milks are treated in this way and labeled "irradiated" on the container. They are better in antirachitic properties than fresh milk usually is. In a few localities fresh milk, too, is enriched in vitamin D by irradiation, or by putting vitamin D substances directly into the milk. Other means of producing milk rich in vitamin D are to feed the cows irradiated foods or to irradiate the cows themselves. Milk increased in vitamin-D content by one

or another of these methods is now sold by a few dairies. This means that it is enriched in vitamin D only, and cod-liver oil rich in vitamin A as well as D may still be needed in the child's diet.

VITAMIN E

Vitamin E occurs to a small extent in the fat of milk, but is so widely distributed in nature that there are many sources better than dairy products. Essential for reproduction, vitamin E is known as the antisterility vitamin.

Vegetable oils, especially the one in the wheat embryo, are among the foods rich in vitamin E. Green lettuce and a number of other vegetables contain considerable quantities, so the limited vitamin-E content of milk is easily supplemented in the diet.

VITAMIN G

Milk, whole or skimmed, is one of the most valuable sources of vitamin G. This vitamin is of daily importance to everyone because it affects not only growth but also health and well-being at all ages. Foods rich in vitamin G help to prevent pellagra, a disease characterized by great decrease in strength, loss in weight, dizziness, indigestion or nervousness or both, and a definite type of skin lesions.

Skim milk, either fresh or dried, buttermilk, and cheese made from skim or whole milk are valuable for their vitamin-G content. Cooked, canned, and dried milk are as good sources as fresh milk, since vitamin G is not readily destroyed by heat.

EFFECT OF HEAT ON NUTRITIVE VALUE

Heat may make some chemical changes in milk, whether applied in food preparation or in destroying bacteria or in making milk curd more digestible for infants.. The heat used in cooking, boiling, pasteurizing, drying, or canning milk has no appreciable effect on vitamins A and G, the two in which milk is especially rich. The person who eats a well-balanced diet supplying the other vitamins can therefore disregard the effects of heat on the vitamins in milk.

Heating causes the coagulation of a small proportion of the protein and the precipitation of some of the calcium salts. These changes and the losses they cause are slight.

Milk is not constipating as is sometimes suggested; it is merely not laxative because it is so completely digested that it leaves no coarse waste material in the intestinal tract. Boiling has no effect on this property. Babies may need honey or one of the other laxative forms of sugar added to their milk formula. The older child and the adult with plenty of cellulose-rich foods have an abundance of refuse from sources other than milk. On the whole, any seemingly undesirable changes caused by the heating of milk are minor when the protection to health and other advantages are considered.

BACTERIA IN MILK

Milk contains a few bacteria even as it leaves the udder of a healthy cow. But by careful control of sanitation it is possible to produce clean milk that contains relatively few bacteria. Clean

healthy cows, clean healthy milkers and helpers, clean covered utensils, and prompt and efficient cooling of the milk are four essentials for the production of clean milk, low in bacteria.[1]

There are many kinds of bacteria, some useful and others harmful. The most common types in milk are those that cause it to sour by converting the milk sugar—lactose—into lactic acid. This change is valuable as a natural method of temporarily preserving milk from putrefaction, and is important in the making of butter and cheese. Some other kinds of bacteria, as they develop, change the color or flavor of the milk, or make it slimy or ropy. Still others, though they seem to have no effect on the milk itself, spread disease. The milk from tuberculous cows, for instance, is not a safe food to take raw because it may contain the bacteria of tuberculosis. Undulant fever in man is sometimes contracted by drinking raw milk from cows having the germs of abortion disease in their udders. Milk from cows that have not been examined for these diseases should be either boiled or pasteurized before it is used.

Bacteria get into milk in a number of ways—from the body of the cow, flies, insanitary utensils, or from persons who often unknowingly carry the bacteria of typhoid fever or diphtheria without themselves being ill. Epidemics of typhoid fever, diphtheria, and septic sore throat have been traced to contaminated milk from a single farm, mixed with the output of other farms.

The same chemical constituents and physical properties that recommend milk as a human food make it an excellent food for bacteria. A single bacterium in milk may increase manyfold in a few hours if the temperature and other conditions are favorable to bacterial growth. Temperatures from 70° to 100° F. are the most favorable for many organisms. Bacteria are very sensitive to heat and cold, a fact of great importance in the handling of milk from the dairy barn to the dining-room table.

COOLING AND PASTEURIZATION

Low temperatures, 50° F. or below, check the growth of bacteria. In modern dairy practice, milk and cream are chilled as soon as possible after milking.[2] As now distributed, milk is from a few hours to as many as 72 hours old before it reaches the consumer. Milk that has not been promptly cooled and kept cold may sour quickly, as it does often in summer between the dairy and the home. Even when there is no evidence of souring, milk that has not been kept cold may contain large numbers of bacteria much more unfavorable in type than those that cause souring.

Temperatures at or above the boiling point of water (212° F.) destroy most bacteria in a very short time, while temperatures around 140° F. are fatal to many bacteria if applied long enough. Heat sufficient to destroy all kinds of bacteria is likely to cause some changes in the chemical composition and the flavor of milk. To kill harmful bacteria, dairies heat milk at a rather low temperature in a process called pasteurization. The usual practice in commercial pasteurization is to heat the milk to at least 142° F., hold

[1] See Farmers' Bulletin 602, Production of Clean Milk.
[2] See Farmers' Bulletin 976, Cooling Milk and Cream on the Farm.

it at this temperature for 30 minutes, and then rapidly cool it. Many cities now require the pasteurization of all except certified and "special" milk before it can be marketed.

Pasteurization does not make milk entirely free from bacteria. However, when done by the best commercial method it destroys such disease-producing kinds as those of tuberculosis, undulant fever, diphtheria, septic sore throat, typhoid fever, and many others. Nor is pasteurization an insurance against future contamination. As great care should be taken of pasteurized milk as of raw milk (p. 15 to 17).

GRADES OF MILK

The organized effort to improve sanitary conditions for production and handling has helped to establish standards for grading milk on the basis of purity. The relation of insanitary conditions to the number and kinds of bacteria in milk and to the spread of disease makes milk standards essential. Especially in selecting milk for infants it is important to have established and dependable standards of purity for both raw and pasteurized milk of different grades in every community. The high standards of sanitation required for producing and handling some grades greatly increases their cost, so that not everyone can afford to use them. Furthermore, the highest grades are not necessary for all purposes. A series of grades of milk, each clearly defined and priced according to quality, allows the consumer to choose according to needs and pocketbook.

The methods of grading and the standards established for grades in various localities are not yet uniform. A milk ordinance which will encourage uniformity in methods of milk control has now been approved by the United States Public Health Service and the Bureau of Dairy Industry. The requirements for sanitation on the farm, in the milk plant, and on the part of each person handling the milk, and the definitions of grades according to these standards, are necessarily very detailed. Brief descriptions of the more important grades of milk as defined by the milk ordinance are given below, because a number of States and cities are now using this system of grading.

CERTIFIED MILK

Certified milk is raw milk of uniform composition and of a fixed and very high standard of purity. It is produced under excellent conditions of sanitation specified by the American Association of Medical Milk Commissions. It must not contain more than 10,000 bacteria per cubic centimeter of milk, and must not be more than 36 hours old when delivered. A local medical commission periodically inspects the cows, milkers, and buildings of dairies that are producing milk of certified quality; analyzes the milk; and issues a label or certificate for each approved dairy to use so long as it continues to meet the standards.

Local supervision may be handled by the medical society of the county, a representative of the State board of health, or the health officer of the city or county. The increased cost of producing certified milk justifies its market price, which is usually about twice that of ordinary good bottled milk. Certified milk should not be confused

with so-called "sanitary" or "special" milk, since such terms have not been clearly defined and do not necessarily indicate exceptional purity or any other special equality.

GRADE A RAW MILK

Grade A raw milk has an average bacterial count not exceeding 50,000 bacteria per cubic centimeter at the time of delivery to the customer. The milk ordinance prescribes definite and detailed conditions of sanitation for the dairy farm producing grade A raw milk. Among the special requirements are rigid medical inspection of each employee of the dairy and tuberculin testing of the cows by a qualified veterinarian.

GRADE A PASTEURIZED MILK

Grade A pasteurized milk is grade A or grade B raw milk which has been pasteurized, cooled, and bottled in a milk plant that conforms to a number of specified requirements of sanitation. The average bacterial count of grade A pasteurized milk must not exceed 50,000 bacteria per cubic centimeter at any time after pasteurization until delivery to the consumer.

GRADE B PASTEURIZED MILK

Grade B pasteurized milk is grade C raw milk which has been pasteurized, cooled, and bottled in a milk plant conforming with all of the requirements for grade A pasteurized milk.

CHOOSING THE FAMILY MILK SUPPLY

Considering the country as a whole, high-quality milk of uniform composition is now available raw, pasteurized, evaporated, and dried. Wherever commercially pasteurized milk of high grade is available, it is likely to be the most widely used form. In food value it is practically the same as raw milk, and from the standpoint of health, it is much safer than most raw milk. The cheaper grades of market milk, raw or pasteurized, often just as high in nutritive value as the more expensive grades, may be used in cooking or for general purposes if food money is limited. They should be boiled for safety to health (p. 17). Canned and dried milk are now widely used, too, and because of their cheapness are a boon to low-cost diets.

The grade or form of milk to select depends partly on standards maintained by the local dairies, and partly on the family pocketbook. If there are young children, the family will buy whole milk in some form if money permits. To be able to choose wisely, every consumer should know what clean milk is according to medical standards, and what conditions are necessary for its production. For this reason a visit to the city milk plant or to a dairy farm from which the local milk supply comes direct, is of value. For unbiased information about local milk supplies, consumers may turn to the local health department. It is not the function of the health department to recommend a milk dealer, but to give information about bacterial counts, fat tests, and the sanitary conditions surrounding each milk supply in the community.

The best way for the consumer to buy market milk is in bottles, stoppered with tight-fitting caps. The type of cap that fits down around the sides of the rim is especially sanitary. Bottled milk can be kept both clean and cool during delivery more easily than loose or bulk milk which is transported in large cans and dipped out into another container when purchased. Dipped milk is a hazard to health because of the numerous chances for contamination during handling. Also, it may be deficient in cream, and it is subject to more chances for adulteration than is bottled milk.

MILK FOR INFANTS

Human milk is normally the best food for an infant, provided the nursing woman is healthy and is on a carefully selected diet which will richly endow her milk with vitamins. Human milk has the advantage of being very low in bacterial count, and it is also slightly laxative. However, there are instances when mother's milk is not available or when the child's condition indicates that the mother's milk is unsatisfactory. Under these circumstances, cow's milk is commonly used as a substitute. Goat's milk has been used with marked success in feeding some infants who have not thrived well on cow's milk.

In chemical composition, the milk of animals differs considerably from human milk, as is shown in table 1. Cow's milk, for instance, is much more concentrated in building materials than mother's milk, because it is secreted for the nourishment of the calf that normally increases its weight much more rapidly than does the human infant. Cow's milk contains about 2½ times as much protein and about 3 times as much mineral matter as human milk. The proportion of fat is about the same in both kinds, but cow's milk has much less sugar or lactose than human milk. These differences in percentage composition can, as a rule, be adjusted if necessary by adding water, some form of sugar, and sometimes fat, following reliable directions for modifying milk for infant feeding. Some infants, however, thrive better on plain cow's milk than on modified.

TABLE 1.—*Average composition of milk of various kinds*[1]

Kind of milk	Water	Protein (N×6.37)	Fat	Lactose (by difference)	Mineral matter (ash)	Fuel value per pound
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Calories*
Human	87.5	1.4	3.7	7.2	0.2	307
Cow	87.1	3.4	3.9	4.9	.7	310
Goat	87.0	3.3	4.2	4.8	.7	318
Sheep	82.6	5.5	6.5	4.5	.9	447
Reindeer	63.7	10.3	19.7	4.8	1.5	1,078

[1] Compiled by Food Composition Section, Bureau of Home Economics.

For infant feeding, the quality of milk is very important. If for a special reason a physician recommends raw milk for an infant, certified or other equally high-grade raw milk should be obtained. Grade A pasteurized milk is entirely satisfactory for babies, and is more commonly used because it is less expensive. Lower grades of raw and pasteurized milk may be used for infant feeding if

necessary, but such milk should be boiled before it is made up in the formula. With dried and evaporated milk of high quality readily available, market milk of questionable quality should not be used in infant feeding.

SOFT-CURD MILKS

Some differences between cow's milk and human milk do not show up in percentage composition and cannot be adjusted by modifying the milk. They have to do with the size of fat globules and with certain characteristics of the protein. The latter is the more important because it influences the way in which milk is digested in the infant's stomach.

The protein of cow's milk is largely casein, which usually forms a solid, rather tough curd in the stomach when milk is taken by itself. The protein of human milk contains much more lactalbumin and coagulates in the stomach in a flocculent, tender curd. In infancy, when little except milk is put into the stomach, the hard curd of most cow's milk may markedly influence digestion, especially if the infant has a delicate digestive system. Also some invalids and convalescents who live largely on a milk diet have difficulty in digesting the hard curd of cow's milk.

The presence of the fat of milk tends to soften the curds for digestion. Whole milk has smaller and softer curds than skim milk, and "top milk" is still better in this respect. Heating changes the curd of milk and makes it more tender for digestion. Milk boiled directly over the fire for 3 minutes or more, and evaporated milk (because it is sterilized at a high temperature during canning), form a tender curd that behaves a good deal like human milk in the baby's stomach. Double-boiler-heated milk and pasteurized milk form a curd somewhat softer than does raw milk, but not so soft as does milk heated at the higher temperatures. Adding a thin cereal gruel or gelatin is another method of making milk curd more easily digested. These materials prevent the casein from coagulating in a hard mass. Dextrimaltose and glucose, forms of sugar widely used in infant feeding, also have a favorable effect on curd formation.

This matter of curd toughness, or "curd tension", is such an important factor in the artificial feeding of infants that in recent years much has been done to find out whether this quality in cow's milk varies with the breed, the feed, or the individual cow. The results, very significant in infant feeding, show that in all breeds some cows give a soft curd and others a hard curd type of milk. Though curd toughness seems to be a characteristic of the individual cow, there is greater chance of finding cows giving soft-curd milk in some breeds than others. More Holstein-Friesian and Ayrshire cows give milk of low-curd tension than do cows of other breeds.

Practical tests for curd toughness have been developed and it is now possible for dairies and milk stations to obtain cow's milk of the soft-curd type and keep it separate to sell for feeding delicate infants and invalids. Some baby specialists believe that soft-curd cow's milk, because of its ready digestibility, is a suitable infant food without being modified. One of the principal reasons that goat's milk has been used so successfully in feeding delicate infants and adults with digestive disturbance is that it forms a tender curd in the stomach.

HOME CARE OF MILK

As soon as milk comes into the home the responsibility for keeping it clean, covered, and cold lies with the consumer. No matter how carefully milk is handled up to this point, it will not keep well if it is then carelessly treated. In the farm home, where milk is likely to be used within 12 hours after it is milked, the problem of caring for it differs somewhat from that in the city where the supply

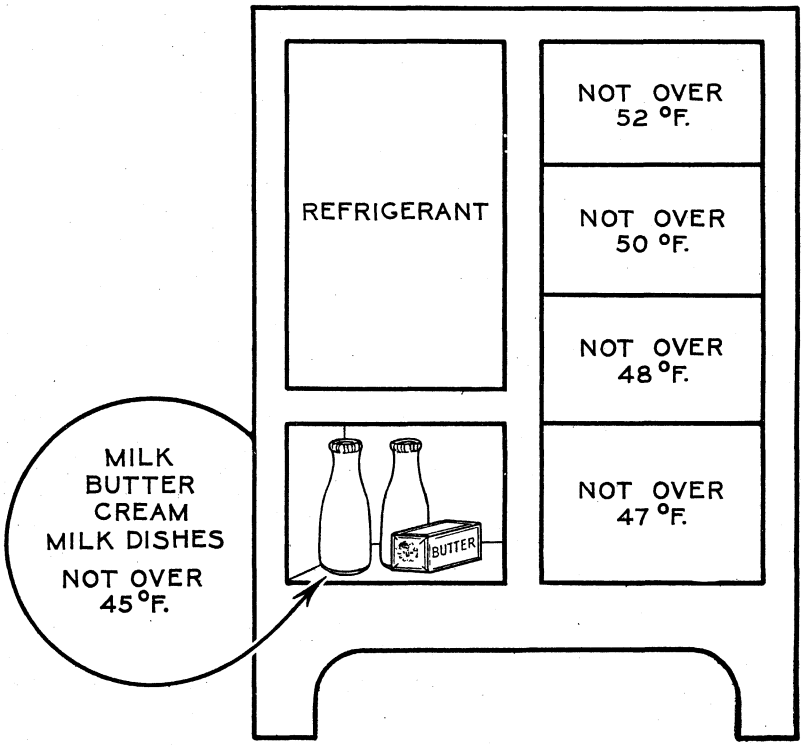

FIGURE 2.—Keep milk in the coldest part of the refrigerator, preferably where the temperature is not over 45° F. Test the temperature of the refrigerator to locate the coldest place.

usually comes once in 24 hours and often from a great distance. Where facilities for keeping milk cold are not available, heating is important.

RULES FOR CONSUMERS

1. Provide a cold, clean place in which to store milk. A refrigerator that holds a fairly constant temperature not higher than 45° F. in the milk compartment is ideal (fig. 2). Under such conditions milk and cream may be kept 24 hours or more. If kept at 50° or above for as long as 24 hours, milk and cream are very likely to be suitable only for cooking. A low temperature is especially important in keeping milk for infant feeding or milk for the family to drink.

Devise some other means to keep milk and cream cool if a good refrigerator of the ice or mechanical type is not available. Use a cold well, basement, or cellar for short-period storage of dairy products. In a dry climate an iceless refrigerator is satisfactory. It is seldom possible to maintain a temperature even as low as 50° F. in any of these devices. Buying milk and cream in small quantities and using evaporated or dried milk help to solve the problem of poor refrigeration.

2. Put milk and other dairy products into the refrigerator or cold-storage place as soon as possible after they are delivered. Milk standing on a sunny porch for several hours in summer may increase in temperature as much as 10° or even 15° or 20°. This causes a tremendous increase in the number of bacteria which no amount of chilling afterward will reduce. If milk cannot be refrigerated at once, ask the delivery man to leave it in a sheltered place or in a covered box. Many city dairies provide their customers with special boxes with hinged covers for this purpose. These not only

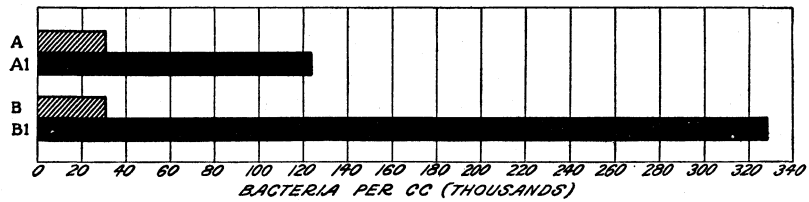

FIGURE 3.—A and B represent identical samples of high-quality raw milk of low bacterial count (31,000 bacteria per cubic centimeter of milk). A' shows the number of bacteria (124,000 per cubic centimeter of milk) in sample A after it was refrigerated for 24 hours at 50° F. B' represents the number of bacteria (328,000 per cubic centimeter) in sample B after it was left standing for 1½ hours at a room temperature of 75° and then refrigerated for 24 hours at 50°. The bacteria increased 4 times in the first sample, and more than 10½ times in the second.

protect the milk from rapid rise in temperature in hot weather but also from meddling cats, dogs, or other animals.

3. Keep milk in the refrigerator as continuously as possible until it is used. Form the habit of putting milk, cream, and butter away first when clearing up after a meal. When using milk in cooking, put the milk container away as soon as the required quantity is measured. More bacteria may develop while milk stands in a hot kitchen for an hour and a half than would develop in the same milk in a cold refrigerator for 24 hours (fig. 3).

4. Keep milk closely covered to exclude not only dirt, bacteria, and particles of spilled food, but also flavors and odors which dairy products readily absorb. Further protect dairy products from absorbing flavors by placing them in the section of the refrigerator where newly chilled air reaches them first. Such odorful foods as onions, cabbage, and fish should be placed where the warmer air is traveling up towards the ice or cooling unit.

5. Never mix new milk with old except for immediate use, because the old milk is likely to contain more bacteria than the new supply. Never pour back into a partly filled container milk that has been out in the air and in another container. Small covered jars and half-pint bottles are convenient for storing small quantities of cream or milk left over from a meal.

6. Clean the top of the milk or cream bottle before removing the pasteboard cap, unless the cap is the kind that fits well down around the mouth of the bottle. Such a cap protects the rim of the bottle from dust, bacteria, and other contamination. If the flat disk cap is used, washing is essential.

7. Wash milk bottles as soon as they are emptied, by rinsing first with lukewarm water and then with hot water. If there is an infectious disease in the house, do not return any bottles except with the knowledge of the health department and under conditions which it may prescribe.

8. Return empty bottles promptly, and do not use them for anything except milk.

DIRECTIONS FOR HEATING

Heating milk in the home to destroy bacteria is not often necessary, now that high-quality milk is available to every community in some form—fresh, canned, or dried—though there are circumstances when heating is still advised. Some doctors recommend boiling any milk that is to be used in infant feeding. If milk of uncertain purity must be used for any purpose or if adequate refrigeration is not available, the day's milk should be heated as soon as possible after it is received. It should then be cooled quickly and stored under the best possible refrigerating conditions, ideally at 45° F.

THREE-MINUTE BOILING

Recent practice seems to favor a short boiling. Put the milk into a kettle large enough to allow for occasional stirring, place it directly over the fire, bring it to the boiling point, and boil for 3 minutes. Cool immediately and quickly by placing the kettle in cold water and changing the water as it takes up the heat; then put the milk at once into the refrigerator or, if it is to be used for infant feeding, make it up at once according to the formula, and then refrigerate it. The advantages of the boiling method are its simplicity, its effectiveness in destroying many undesirable bacteria, and good effect on the digestibility of the casein (p. 9). Disadvantages of this method sometimes mentioned are the change in flavor, the danger of scorching, a small loss of calcium salts when the proteins coagulate on the pan, and the destruction of vitamin C. Not one of these is serious. The slightly different flavor of boiled milk is not unpleasant. Scorching is very unlikely if the flame is kept low enough to prevent the milk from boiling over. The coagulated material can and should be scraped up and used, and as for vitamin C, even raw milk is not a dependable source of this vitamin.

DOUBLE-BOILER HEATING

Double-boiler heating, incorrectly called "slow boiling," is recommended also, and is another good home method of reducing the number of bacteria in milk. For it, use a double boiler that has twice the capacity of the quantity of milk to be heated; for example, a quart size for a pint of milk, or a gallon size for 2 quarts. Put the cold milk into the top of the double boiler, and put cold water into the lower compartment. Have the water touch the bottom of the upper kettle

so that the milk will begin to heat up as soon as the water does. Keep the double boiler over a slow flame until the water in the bottom part has boiled for 8 minutes. Then remove the top kettle which contains the milk; place it in cold water, preferably ice water; cool the milk rapidly by changing the water as it becomes warm; and put it into the refrigerator immediately.

There is less change in the flavor of the milk when the double boiler is used, no danger of scorching, and practically no precipitation of nutritive material. The vitamin C is destroyed and the curd is not so fine as that of boiled milk, though it is usually finer than that of pasteurized milk. So far as destroying bacteria is concerned, the results are less uniform from time to time than when the boiling method is used.

HOME PASTEURIZATION

Pasteurization—heating to a specific temperature and then quickly cooling—is the third method. For this a thermometer is necessary.

Milk for general use is conveniently pasteurized in the bottles in which it is delivered. Remove the cover from one bottle, pour out a little of the milk, punch a hole in the cover, replace it, and insert a thermometer. Then set all bottles of milk on a rack in a pail filled with cold water nearly to the level of the milk, and heat until the thermometer in the milk registers 145° F. Remove the pail from the heat and leave the bottles in the hot water for 30 minutes, reheating if that is necessary to keep the milk at 145° F. After the 30-minute period, replace the hot water gradually with cold until the milk has cooled, preferably using ice in the last water. After cooling, keep the bottles in the coolest place available.

MILK PRODUCTS

The average composition of milk and its various products is shown in table 2, and some of the most important products of milk are then discussed in detail.

TABLE 2.—*Average composition of milk and milk products* [1]

Product	Water	Protein (N×6.37)	Fat	Lactose,[2] etc. (by difference)	Mineral matter (ash)	Fuel value per pound
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Calories*
Whole milk	87.1	3.4	3.9	4.9	0.7	310
Cream:						
Single	72.5	2.9	20.0	4.0	.6	942
Double	54.4	2.2	40.0	3.0	.4	1,727
Skim milk	90.5	3.5	.2	5.0	.8	162
Buttermilk	90.7	3.5	.5	4.6	.7	167
Whey	93.0	1.0	.3	5.1	.6	123
Evaporated milk, unsweetened	73.7	7.0	7.9	9.9	1.5	629
Condensed milk, sweetened	27.0	8.1	8.4	[3] 54.8	1.7	1,484
Dried whole milk	3.5	25.8	26.7	38.0	6.0	2,248
Dried skim milk	3.5	35.6	1.0	52.0	7.9	1,630
Butter	15.5	.6	81.0	.4	2.5	3,325
Cheese:						
American cheddar	34.5	25.6	34.7	1.9	3.3	1,916
Swiss	34.0	28.6	31.3	1.9	4.2	1,831
Cottage (skim milk)	74.0	19.2	.8	4.3	1.7	459
Cream	42.7	14.5	39.9	1.0	1.9	1,910

[1] Compiled by Food Composition Section, Bureau of Home Economics.
[2] Including lactic acid and other undetermined substances. The amount of sugar in some of the cheeses is probably negligible.
[3] Mainly added sucrose. Average percentage of added sugar is about 42 percent of the condensed milk

CREAM AND BUTTER

Cream contains the same constituents as milk, but in very different proportions. Cream of course is much richer in fat than milk, the exact degree depending upon both the method and the extent of separation. The fat content averages about 20 percent in thin or "coffee" cream and about 40 percent in thick or "whipping" cream. Since the vitamin A and vitamin D of milk are associated with the fat, thick cream is a much more concentrated source of these vitamins than is thin cream, while thin cream is in turn a better source than whole milk.

The heat necessary in pasteurizing cream causes it to lose some of its body and sometimes to separate slightly; therefore many dairies now homogenize their cream after pasteurizing. This mechanical process makes the fat globules so fine that they show no tendency to rise to the surface. This is an advantage, except in cream for whipping. For this purpose raw cream, which is neither pasteurized nor homogenized, is best. The effect of these processes as well as of other conditions on the whipping quality of cream is discussed in United States Department of Agriculture Bulletin 1075, The Whipping Quality of Cream.

Butter averaging over 80 percent fat is milk fat in a very concentrated form. Among milk products it is the best source of the fat-soluble vitamins A and D, and among foods in general, butter is an outstanding source of vitamin A. In fact, butter supplies a large proportion of the vitamin A requirement of many persons, because it is used on the table and in cooking.

The flavor and texture of butter influence price to some extent, but have very little effect on nutritive value or digestibility. These qualities are an index of care and cleanliness in making and handling butter.

The high fuel value of butter and cream and the many ways in which they can be used in food preparation make them valuable to the person who wishes to gain weight. Though butter and cream are often added to a soup, sauce, or dessert chiefly to improve flavor and texture, these fat-rich foods increase the calories and the vitamin content of the dish at the same time. They are usually considered the most easily digested of the common fat foods, but, like any other concentrated fat, heavy cream and butter may cause disturbance if eaten in overlarge quantities.

SKIM MILK

Skim or separated milk contains a large proportion of the proteins, sugar, minerals, and vitamins B and G of the milk. In both its fresh and dried form skim milk is of great value in preventing pellagra. So much of the fat of the whole milk has been removed that skim milk is lower in fuel value, less rich in flavor, and a very poor source of vitamin A as compared with whole milk. An ounce and a half of butter along with a quart of skim milk provides the equivalent food value of a quart of whole milk.

Skim milk has long been an important feature of the diet of many farm families. In the low-cost diet of farm as well as of urban families skim milk is especially valuable because it provides protein,

calcium, and vitamin G abundantly and cheaply. Whenever price prohibits the use of adequate quantities of whole milk for adults or children, at least part of the milk supply may well be used in the form of the skimmed product, if care is taken to furnish other sources of the fat-soluble vitamins A and D. An abundance of skim milk in the child's diet when no whole milk can be provided is a valuable aid to growth.

In diets to reduce body weight or to prevent rapid gain of weight in adults, skim milk is important in filling the constant need for calcium. In this particular type of diet that must be low in fuel value, skim milk is more suitable than whole if its deficiency in vitamin A is made good.

CHEESE

Cheese represents most of the solids of the milk from which it is made, with the exception of the lactose or milk sugar. A large proportion of the lactose, some of the protein, and a part of the vitamin and mineral content remain in the whey or liquid residue from cheese making. Because of its concentration, cheese is very high in nutritive value. Cottage cheese, made from skim milk, is an excellent and inexpensive source of protein, of vitamins B and G, and of calcium and other minerals. The soft domestic package cheeses, such as Neufchâtel and cream cheese, are richer in fat and higher in fuel value than cottage cheese. Neufchâtel is usually made of whole milk; soft cream cheese is made of cream or of extra-rich milk containing at least 6 percent of fat.

The hard, cured cheeses such as American cheddar and domestic swiss are usually made of whole milk, or of milk standardized to a definite fat content. If not made of whole milk, cheddar cheese is described as " part skim " or " skim ", and is correspondingly lower in fuel and vitamin values, as well as in cost.

The flavor of cheese depends somewhat upon the proportion of fat in the milk used, partly on the type of milk—sweet, soured or buttermilk—but more largely on the method and degree of curing and the kind of organisms which cause the curing. Detailed information about various kinds of cheese, their uses in the diet, and home methods of making domestic types, is found in Farmers' Bulletins 960, Neufchâtel and Cream Cheese: Farm Manufacture and Use; 1191, Making American Cheese on the Farm; 1451, Making and Using Cottage Cheese in the Home; and Department Bulletin 608, Varieties of Cheese: Descriptions and Analyses (revised 1932).

CONCENTRATED FORMS OF MILK

Milk may be greatly decreased in bulk and improved in keeping quality and convenience of storage and shipment if a large proportion of the water in it is driven off. The milk is reduced to the thick creamy consistency of condensed and evaporated milks, or to the powdered and flaked forms of the dried-milk products.

The terms " condensed " and " evaporated " as used in the trade refer to somewhat different products. " Condensed milk " is not only reduced in water content, but also has sugar added to assist in its preservation. " Evaporated milk " is simply reduced in water content and then canned without added sugar.

The market offers several dried-milk products, but dried whole milk, dried skim milk, and dried partly skimmed milk are the kinds most commonly used in the home at present. They differ somewhat in food value, flavor, and keeping qualities because of the difference in the quantity of fat each contains. Some dried-milk products are irradiated, and are therefore enriched in vitamin D.

The low cost and the convenience in carrying and storing canned milk and dried milk have encouraged their use in camp, tourist, and home cookery, and in infant feeding. These concentrated forms are especially valuable when travel or any emergency makes it necessary to change the milk supply of the infant or young child.

CONDENSED MILK

In preparation of condensed (sweetened) milk, about 18 pounds of sugar are used for every 100 pounds of pure fresh cow's milk, and the mixture is evaporated in a vacuum at a temperature similar to that of pasteurization. One pound of condensed milk represents about 2¼ to 2½ pounds of fresh milk. The final product is much thicker than unsweetened evaporated milk, because of the sugar added. Condensed milk may be diluted and used in some of the same ways as fresh milk, but it is so sweet that it should not be used for infant feeding unless a physician recommends it.

EVAPORATED MILK

Evaporated (unsweetened) milk is pure, fresh, cow's milk with much of its water removed by evaporation in vacuum pans. About half of the total weight of the fresh milk is evaporated. When the milk reaches this concentration, it is put through a homogenizer to break the fat globules into a much smaller size. The milk is then run into cans, sealed, and sterilized under steam pressure at a temperature well above that of boiling water. An unopened can of evaporated milk will keep indefinitely, but once opened it must be handled and kept cool like any other milk.

One pound of evaporated milk represents on the average 2 pounds of fresh whole milk. Seventeen ounces of evaporated milk contains about the same quantity of solids as a quart of whole milk. Evaporated milk diluted with an equal measure of water may be used in most of the same ways as fresh milk. Where it is lower in price than market milk, it takes an important place in the low-cost diet.

The high temperature of canning changes the flavor of the milk somewhat, giving it a cooked though not unpleasant taste. It affects the casein and makes it more easily digested. The casein of evaporated milk is coagulated in the stomach in a fine, flocculent, tender curd, very easily managed by the delicate digestive systems of invalids and of babies. The curd formed by evaporated milk is very similar to that of mother's milk. Other advantages of evaporated milk in infant feeding are its fine fat globules, and the fact that it is bacteria-free when the can is opened.

Because it has been heated, evaporated milk has a somewhat lower vitamin content than the fresh milk from which it is made. It is a good source of vitamins A and G, but like other milk it needs to be supplemented by foods rich in vitamins B, C, and D.

DRIED MILK

The four principal methods used in the manufacture of dried milks are the spray, roller, vacuum-drum, and Campbell-flake processes. The products resulting from these four processes differ considerably in texture and in the measure or volume of a given weight.

One hundred pounds of fresh whole milk can be reduced to about 13 pounds of fine white powder containing all of the protein, fat, sugar, and minerals, and practically all of the vitamin content of the original milk except vitamin C. Dried whole milk is now distributed in sealed containers to prevent the fat from becoming rancid. After the seal is broken, the milk should be tightly covered again and stored in a cool place to delay changes that impart a rancid flavor. Under the Federal Food and Drugs Act, dried whole milk must contain not less than 26 percent of milk fat and not more than 5 percent of water. It has about 35 percent higher fuel value than dried skim milk.

One pound of dried whole milk (about 4½ cups if made by the spray process) furnishes approximately the same quantity of milk solids as 3½ quarts of fresh whole milk. Four and one half ounces of dried whole milk when mixed with 3½ cups of water makes approximately a quart of fluid milk, equal in solids to a quart of fresh whole milk. Dried whole milk may be used where high-quality market milk is not abundant or where refrigeration facilities are poor. It may replace or supplement fresh whole milk in food preparation (p. 24). High-quality dried whole milk when properly reconstituted with water tastes and looks so much like pasteurized market milk that it is equally pleasing to drink.

Dried skim milk, because it contains practically none of the fat of whole milk, has the best keeping qualities and the lowest price of any type of dried milk. Though it is much lower in fuel value than dried whole milk and has practically no vitamin A and D content, it is very valuable for its building materials. Dried skim milk makes all of the same contributions to nutrition as fresh skim milk except vitamin C. It provides the protein, minerals, lactose, and vitamins B and G of milk at very low cost.

Dried skim milk is cheapest when bought by the barrel. It is available at wholesale rate also in 25- and 50-pound containers. Such an amount can often be purchased jointly by several families and divided among them. Local bakers and ice-cream manufacturers are sometimes willing to sell small quantities of dried skim milk from their supply. Some manufacturers of dried skim milk put up 1- and 5-pound packages which retail at a price per pound considerably above the wholesale price.

One pound of dried skim milk (about 4 cups spray process) furnishes the same quantity of milk-solids-not-fat that is furnished by about 4¾ quarts of fresh skim milk. Three and one half ounces of dried skim milk made into a liquid with 3¾ cups of water equals about a quart of fresh skim milk in solids and in measure.

Dried skim milk reconstituted to fluid form can be used in any dish that calls for fresh skim milk (p. 24). It is especially valuable when used in conjunction with fresh fluid milk to increase the nutritive content of bread and other baked products, vegetable dishes,

soups, and desserts. Dried skim milk may be added to the fresh whole milk that children drink, to increase the percentage of milk-solids-not-fat in the growing child's diet. As much as 1 to 1½ ounces of dried skim milk (about one fourth to three eighths of a cup) may be added to 1 quart of fresh milk without appreciable change in the flavor or consistency of the fresh milk. Such an addition makes a significant increase in the food value of the milk.

Dried skim milk has improved the diet in thousands of homes and in many institutions where only a limited amount of money could be spent for food. It has been used with remarkable success in the prevention and cure of pellagra. The concentrated nutritive value of dried skim milk, along with the ease of shipping and storing and its low price in wholesale lots, make it extremely valuable to welfare and relief organizations feeding large groups in times of emergency.

The various kinds of dried milks have many qualities to recommend them for infant feeding. Each of them—whole, skimmed, partly skimmed, and modified—is a sanitary product of fairly uniform composition. When properly prepared and used immediately, reconstituted dried milk is very low in bacterial count. Its flavor is pleasing and not very different from that of fresh milk. It is easily digested, a quality which is always an asset in infant feeding. The quantity to use in making up the formula for an infant depends upon the kind of dried milk selected, and the age of the child, and should usually be determined by a physician. For infants, it is especially important to supplement the vitamin content of the dried milk with other foods.

FERMENTED MILK [3]

In this country buttermilk has been for years the most widely used kind of fermented milk, though acidophilus milk is now well known and even the kefir, kumiss, and yogurt of central Asia and Turkey are familiar here. The characteristic flavor of any fermented milk is due to the kinds of bacteria that bring about the fermentation. All fermented milks contain large numbers of lactic-acid bacteria and most of them contain other desirable bacteria as well as yeast plants. The beneficial effect of these fermented-milk products is due in part to their ability to help overcome excessive putrefaction in the intestinal tract, and in part to the fine, tender, easily digested curd which they form in the stomach. Though their value may be overemphasized by some enthusiasts, these products are beneficial to many babies and to adults with digestive disturbances. Lactose, because it encourages the growth of lactic-acid bacteria, is usually recommended to a person on a fermented-milk diet.

Buttermilk is, accurately speaking, that portion of milk or cream remaining in the churn after the butter is removed. If cream is churned when sweet, the buttermilk is not very different from ordinary skim milk, but as a rule cream is churned when sour, and the buttermilk is slightly acid and has a coagulated curd broken up into very fine particles. Buttermilk is widely used on farms where it is a by-product of buttermaking.

Many city dairies handle buttermilk. In addition to true buttermilk, a large quantity of "cultivated" buttermilk is now manufac-

[3] See Department Bulletin 319, Fermented Milks, for fuller discussion of these products.

tured by dairies. Cultured buttermilk is made by first ripening raw or pasteurized milk (skimmed, partly skimmed, or whole) with lactic-acid bacteria cultures, and then stirring the curd until it breaks up into fine particles, just as during churning.

Buttermilk is similar to skim milk in food value. It contains most of the protein but very little of the fat of whole milk. Much of the lactose, or the lactic acid that has been developed from it, remains in the buttermilk. Buttermilk, like skim and whole milk, is a fair source of vitamin B and an excellent source of vitamin G, which places it high in the list of pellagra-preventing foods. The food value of cultured buttermilk depends upon the composition of the milk from which it is made. If skim milk is used with the cultures, the food value of the resulting buttermilk is like that of true buttermilk just described. If either whole or partly skimmed milk is used, the fat and vitamin A content are correspondingly higher.

Though buttermilk is most often served as a beverage, either plain or as buttermilk lemonade (p. 27), it may be used in practically the same way as sour milk in cookery, and can also be made into a frozen product.

MILK IN FOOD PREPARATION

Milk used in the preparation of other foods can add materially to the nutritive value of meals. Evaporated milk and dried milk are as valuable as fresh milk for food preparation. Evaporated milk may be used in its full concentration, but diluted with an equal measure of water it is more like fresh milk in food value and consistency. Dried milk, too, may be used in concentrated form or after it is restored to fluid form. In preparing breakfast cereals and quick breads and mixtures using starch, the dried milk may be sifted or mixed in with the dry ingredients, and water substituted for milk in the recipe.

To reconstitute dried skim milk into a fluid, use the proportion of ¼ of a cup of the powder (measure based on spray process) to 1 scant cup of water (a cupful with 1 tablespoonful removed). With the dried whole milk, use ⅓ of a cup of the powder (spray process) to ⅞ of a cup of water (a cupful with 2 tablespoonsful removed). Use either cold or slightly warm water. Boiling water is likely to make the mixture lump. An easy method of mixing is to put the measure of water into a bowl, pour the measure of dried milk on the surface of the water, and beat with a Dover beater or an egg whip. As paste forms on the sides of the bowl, scrape it into the water and continue beating until the fluid is smooth.

Cooking with milk is an easy means of helping adults get their daily milk quota if they dislike to drink it. If a child develops a milk prejudice the problem is not so easily solved because it is more difficult to put the child's full quota of a quart a day into his prepared food. It can be accomplished, however, by cooking his cereal in milk, serving him milk soups and creamed dishes, flavored milk beverages, hot milk toast, and such milk-made desserts as custards, puddings, sherbets, and ice cream. The task is simplified if at least a part of the milk is used in a concentrated form. Adding dried milk to milk-containing dishes, and using fresh milk to dilute evaporated milk are good means of increasing the milk content of

a dish without adding to its volume. Using undiluted evaporated milk or a concentrated fluid made of dried milk instead of fresh milk may accomplish the same purpose. However it is done, concealing milk in prepared dishes is a good means of protecting a child's nutrition while he forgets or is helped to overcome his prejudice against milk.

CREAMED DISHES AND GRAVIES

Milk and vegetables served together in creamed dishes supplement each other especially well in food value. Protein foods—meat, poultry, fish, shellfish, and hard-cooked eggs—are often served creamed also. The foundation of creamed dishes is white sauce made of milk, butter, flour, and salt. White sauce is made in varying consistencies according to its intended use, as table 3 shows:

TABLE 3.—*Proportions for ingredients of white sauce*

Consistency	Milk	Flour	Butter or other fat	Use of sauce
	Cup	*Tablespoon*	*Tablespoon*	
Thin	1	1	1	Heavy milk soups.
Thin-medium	1	1½	1½	Creamed dishes of starchy vegetables or of cereals; also gravy.
Medium	1	2	2	Creamed dishes of succulent vegetables, hard-cooked eggs diced meat, and fish; also gravy.
Thick	1	3	2-3	Binder for croquettes, meat loaf, and souffles.

The ingredients for white sauce may be combined in any of several ways. Choice of method depends upon the quantity of sauce to be made and upon the proportion of fat to flour. When equal quantities of fat and flour are used and not more than a pint of sauce is being made, the following method is economical of time and utensils and yields a smooth sauce: Soften the fat or melt it at a very low temperature, blend thoroughly with the flour, add the milk, and heat slowly, stirring constantly until the mixture thickens, and boil until the starch is cooked. In making more than a pint of sauce, use the same method of blending fat and flour, but add hot milk and finish the cooking in a double boiler to save time and the energy required for stirring. For a very large quantity of sauce mix the flour into a thin paste with cold milk, combine this paste with the rest of the milk which has been heated, stir while cooking, and beat in the fat at the last.

Some vegetables such as cabbage, spinach, carrots, and asparagus are delicious and retain more food value and attractive flavor and color if they are cut in small pieces or shredded, cooked for a few minutes in whole or in top milk, and then seasoned and thickened. Recipes for such dishes sometimes describe them as "quick-creamed vegetables" or "5-minute cabbage."

Grated cheese may be added to the white sauce of some creamed dishes to give them a richer flavor and greater food value. A rich cheese sauce of this kind poured over crisp toast makes a very pleasing and satisfying luncheon or supper dish, especially if served with a succulent vegetable, cooked or in a salad.

Milk gravies are made in the same way as white sauce, except that drippings from meat are used as the fat. The consistency of gravy is a matter of individual preference, and varies from that of thin-medium to medium white sauce. (See table 3.)

SOUPS

Milk soups offer an attractive and nutritious way of combining milk with other foods in the main dish for luncheon or supper. Vegetables often used in milk soups are onions, corn, asparagus, cabbage, cauliflower, peas, potatoes, turnips, beans, tomatoes, celery, and spinach, either alone or in pleasing combinations. Peanut butter, salmon or other fish, or grated cheese may be used as the main flavoring material in place of the vegetables.

Milk soups are as thin as or thinner than thin white sauce. (See table 3.) The proportion of flour to use varies from ½ to 1 tablespoon for each cup of liquid. For the liquid, use either all milk or, in the case of vegetable soups, a combination of milk and the juice and the mashed or strained pulp of the vegetables.

For the sake of variety, to conserve food value and flavor, and to give the soup more body, especially if it is for children, use the following method: Grate the raw vegetables or chop them fine, cook them in milk until almost done, add the seasoning, fat, and flour, and continue the cooking for about 5 minutes. Or, if preferred, first thicken the milk to the consistency of thin white sauce and then add the raw chopped or grated vegetables and cook for about 10 minutes in a double boiler.

Egg yolk combined with milk vegetable soups just before serving adds to their richness in protein, fat, iron, vitamin A, and vitamin D.

CHOWDERS

Fish and clam and other shellfish chowders are nutritious and appetizing dishes that contain a good deal of milk. Chowders of excellent flavor and consistency may be made from a combination of fresh and evaporated milk.

Other chowders are made by substituting for the fresh fish small portions of left-over cooked or canned fish, salt codfish, or dried beef. The so-called vegetable chowders are made of corn, lima beans, sliced carrots, or other vegetables.

BEVERAGES

Flavored milk beverages afford pleasing variety to children and other persons who take large quantities of milk daily. The flavors appeal to those who do not like to drink plain milk, or who prefer any food prepared in some unusual way.

Chocolate and cocoa are probably the most popular milk beverages the year around because they are good either hot or ice-cold, and they are easily and quickly made at home. In camp or tourist cookery and in low-cost diets they are featured because they may be made not only of fresh whole or skim milk but equally well of milk reconstituted from the dried, evaporated, or condensed products.

Questions are often asked about the suitability of chocolate and cocoa in flavoring milk for young children. Of the two, cocoa is the more suitable because it is less rich in fat. However, both cocoa and chocolate contain theobromine, which acts as a stimulant, and both are undesirable to use in large quantities or frequently in the diet of children. Used occasionally and not too strong, cocoa adds pleasing variety to milk beverages and milk desserts.

Cafe au lait, which is merely hot milk flavored with a little very strong coffee, has greater food value than ordinary coffee and cream, but because of the caffeine it is not a good drink for children.

Milk shakes and eggnogs are nutritious drinks. To make a particularly smooth eggnog, beat hot milk into the egg, add the desired flavoring, and then chill the mixture before serving. The proportion of flavoring to use in all of these milk beverages depends on individual taste. Children and invalids generally prefer them rather delicately flavored. Shaking or beating milk drinks until they are frothy when served adds to their attractiveness.

A mixture of equal quantities of milk and cream—often called "half and half"—and a combination of buttermilk and cream are richer in flavor and in food value than is plain milk. Ice-cold buttermilk lemonade is a refreshing and nutritious drink when made with buttermilk and somewhat more lemon juice and sugar than used in ordinary lemonade. Whey is sometimes flavored with fruit juice, sweetened, and served as a beverage.

BATTERS AND DOUGHS

Milk used in bread improves its flavor, texture, and food value, and helps to make it brown. All forms of milk may be used to good advantage in quick breads: Sweet milk—whole or skim—fresh, canned, or dried; sour milk, buttermilk, and sour cream. Using some form of milk rather than water in baking is an excellent and inexpensive way to reinforce the nutritive value of the low-cost diet.

Milk or cream that has been pasteurized or boiled sours slowly because of the decrease in the number of lactic-acid bacteria. To hasten the souring of such milk or cream, pour it from the bottle into another container to introduce these bacteria from the air, cover, and keep at room temperature.

When baking with sour milk or sour cream, use the smallest amount of baking soda that will neutralize the acid. One half of a level teaspoon of soda for each cup of sour clabbered milk or cream is sufficient. For milk that is just turning sour, half that proportion of soda may be enough.

DESSERTS

The list of puddings and desserts using a large proportion of milk is almost endless, but they all group together in a few main types.

Junket is one of the simplest, made merely of sweet, flavored milk, thickened to a custardlike consistency by means of a rennet preparation. Caramel, maple, almond, and vanilla are good flavorings for junket. Crushed fresh fruits or fruit sirups or crushed peanut brittle or cinnamon and sugar may be served with it for variety. Serving cream over junket adds to its flavor and food value.

Sweet curd, made in the same way as junket except that the thickened milk is broken up and the whey strained off, is a good filling for pies and tarts. To the curd from one quart of milk add 1 tablespoon butter, ¼ cup sugar, 2 egg yolks or 1 whole egg, a few dried currants or chopped raisins, and the desired spice. Fresh curds and whey is still a favorite dish wherever cheesemaking is carried on.

Devonshire clotted cream deserves to be better known in the United States than it is. It has a nutty flavor that combines especially well with fruits and various desserts. To prepare it, slowly heat containers of milk on which the cream has been allowed to rise undisturbed; then cool, and skim off the thick, clotted cream. This process not only develops a characteristic flavor but checks development of bacteria, so that clotted cream keeps better than ordinary cream.

Many nutritious puddings are made by slowly baking sweetened milk with a cereal—such as rice, corn meal, or buttered bread—with raisins or some other dried fruit or a spice for flavoring. To make creamy rice pudding, add 3 tablespoons rice to 1 quart milk, ⅓ cup sugar, ½ teaspoon salt, ½ teaspoon nutmeg or cinnamon, and dried fruit if desired. Bake the mixture slowly until it thickens to a creamy consistency and the rice grains are soft and several times their original size. These puddings are served hot or cold, with or without cream or a sauce. Hot baked Indian pudding served with ice cream is a favorite combination in New England.

Some of the milk puddings most popular with children are thickened mainly with cornstarch or with tapioca, and may be varied by different flavorings or by serving with fruit sauces. Beaten egg adds lightness and food value.

There are also the true custards, consisting of milk thickened only with egg, and either cooked in a double boiler or baked in a slow oven. The proportion of five eggs to a quart of milk gives a soft custard of medium consistency or a firm, though tender, baked custard. Bavarian, Spanish, and other creams are made chiefly of milk or cream flavored in various ways and stiffened with gelatin or with a combination of gelatin and egg.

Milk sherbets, frozen custards, and ice cream are ways of serving milk and cream that most persons find attractive. The food value of these frozen-milk desserts depends, of course, on the proportion of milk or cream to flavoring material, a fact that should not be overlooked when they are served to children.

POINTS TO REMEMBER

Milk is valuable for the nutrition of young and old, sick and well, inactive and hard working.

A generous daily quota of milk is especially necessary during the years of rapid growth.

Milk has no equal among foods as a source of calcium, which is needed by everyone for sound teeth and strong bones.

The proteins of milk are unusually efficient for growth and are valuable throughout life in maintaining tissue in good condition.

Milk is unique among foods because each of the six vitamins now known is found in it in small or large quantities. Milk fat is often

used as the principal source of vitamin A in the diet, and skim milk of vitamin G.

In the low-cost diet milk is prominent because it provides high-quality protein, calcium, and vitamins A and G cheaply.

Dried, evaporated, and condensed milk are often used to advantage in place of fresh milk. Skim milk, in either liquid or dried form, is an important food material.

Artificial feeding of infants has lost many of its hazards since clean milk of low bacterial count has come on the market raw, pasteurized, canned, and dried. If soft-curd milk and vitamin-enriched milk become more generally available, infant feeding will be further simplified.

It is the responsibility of the consumer to know what clean milk is, to demand it in every community, and to keep milk in a cold, clean place from the time it is delivered until it is used.

A good refrigerator that holds a low, constant temperature in the milk compartment is a safeguard to health.

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